

Svizzero, Michael

From: Gerhard, Sasha
Sent: Friday, January 24, 2014 4:21 PM
To: Svizzero, Michael
Subject: FW: Additional Questions for Entsorga
Attachments: NIR Spectroscopy for PVC Removal.pdf; NRTCompanyOverview.pdf; SpydIR brochure.pdf

Email for 10/09/13.

-----Original Message-----

From: Jonathan Birdsong [<mailto:jbirdsong@bwstrategies.com>]
Sent: Wednesday, October 09, 2013 10:48 AM
To: Spells, Charlene; Cozzie, David; Faison, George; Gerhard, Sasha
Subject: Additional Questions for Entsorga

Charlene, David, George and Sasha - Attached below are answers to your questions from the end of September.

1. EPA needs more information about the performance of the proposed NIR system to be used at the West Virginia plant. Is test data available that shows the effectiveness of the proposed NIR system at reducing the chlorine content of the waste which will be processed in West Virginia?

Entsorga will utilize NIR spectroscopy technology - specifically the NRT SpydIR (<http://www.nrtsorters.com/equipment/the-spydir/>). This technology will detect and eject 99% by weight of all non-black PVC materials from a waste stream. This technology is proven and in operation in over 15 states across the country including: California, Nevada, Colorado, Texas, Illinois, Georgia, Alabama, Utah, New Mexico, Oklahoma, Arkansas, Wisconsin, Ohio, North Carolina and Rhode Island. Data on the equipment's capabilities are attached.

2. Can Entsorga regulate the moisture content to be held at 15% consistently? What is the process to keep that consistency?

Yes - A unique proprietary characteristic of Entsorga Hebiot MBT biological treatment step is that forced air is alternatively blown into and sucked from the waste piles (zone by zone), creating the so called "reverse-flow bio-reactor". This is a strong differentiator of the Entsorga MBT process in comparison to other available MBT processes providing numerous process efficiencies.

The "reverse-flow" system enables Entsorga to control the moisture and bio-degradation more uniformly through the cross section of the waste pile and improve bio-stabilisation rates. As a result it can achieve lower moisture contents in shorter time compared to other existing MBT processes, thus improving overall process efficiency, allowing to produce a homogenous fuel conforming to the tight specifications of the final users.

The moisture of the material is continuously controlled by means of moisture evaluation software that gives an indication of the drying level of the waste and maximize the decay. The software estimates the moisture level by applying a complex algorithm which relies on the values of temperature, humidity and flow rate of the air extracted from the waste mass. When the stabilizing mass has reached the expected level of moisture reduction (~15%), the drying process stops.

3. What are the measures to ensure consistency/homogeneity on a day-to-day and batch to batch basis? How does Entsorga intend to monitor this?

The waste treatment is a full process lasting up to 14 days and employing both mechanical and biological treatment under strict continuous monitoring by an automated system supporting the operators.

A SRF Quality Management System will be implemented at the facilities in order to constantly control the fuel characteristics and its conformity to the needs and specifications required by the users. On a daily basis, an automated sampling device will extract representative SRF samples from the production stream to be analyzed according to the Monitoring Plan in order to control a wide array of potential pollutants and to verify SRF quality and environmental safety.

The Monitoring and Analysis Plan (MAP) is defined by the Technical Direction (Quality and Environment) in agreement with the Laboratory Direction. The MAP is issued in the plant Intranet and is annually revised to ensure highest quality. An example of a MAP that would be used for the Martinsburg facility can be found on pp. 23-24 of the material Entsorga submitted to the EPA on 3/15/2013.

4. Verify that Entsorga will only be using black bag material (i.e. no chemical inputs).
- Answer YES - only black bag material.

5. Provide a picture of the SRF. (Provided earlier)

Thanks and please let me know if you have any additional questions or comments. I will adjust my schedule for any other meetings/calls that you would like to have.

Sincerely,

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NIR Spectroscopy for PVC Removal

Vibrational spectroscopy is a versatile tool for determining the molecular structure of a material. There are three vibrational spectroscopy techniques that are commonly used: near-infrared (NIR), mid-infrared (MIR), and Raman. The particular spectroscopic method utilized is dependent upon the application. Of particular interest for process analysis (including material identification in waste streams) is NIR due to the relatively low cost, robust components commercially available.

Molecules are not static systems. Depending upon the type of atomic bonds there are various modes of movement between the atoms in the molecules. For NIR spectroscopy we are primarily concerned with vibrations between the atoms. The energy level for a given molecule will be quantized, meaning that only specific energy levels are allowed. NIR spectroscopy is based upon the overtones and combination vibrations of C-H, O-H, and N-H bonds which occur in the spectral region beginning just beyond visible light (750 nm) and stretching out to about 2500 nm. Fundamental absorption in the MIR occurs when bond energy is excited to the first excited energy level. This provides the strongest absorption of energy but is less penetrative than NIR radiation. Overtones are the result of energy jumping from the ground state to the second and higher excited energy states. While such transitions are less likely they still provide adequate signal level for identification of most organic materials. Combination spectral information arises from the interaction of two or more simultaneous molecular vibrations. NIR spectra tend to have more broadband information than MIR spectra since there are combinations of many different overtones/combinations represented.

Figure 1 is a spectral plot for some common polymers. Notice that each polymer has distinctive characteristics. These characteristics are the results of the vibrational overtones and combinations and provide a good foundation for identification and sortation. Note that these characteristics will also be distinct from other materials in the waste to energy stream. Some materials, such as polymers with carbon black which has a broadband absorption over the entire NIR region, may not provide adequate signal level for identification in this region.

Integration of NIR spectrometer systems with appropriate lighting, inexpensive glass optics, high speed data acquisition and computational systems, and precision ejection systems allows for the creation of highly accurate optical sorting equipment. NRT is at the forefront of high speed optical sorting of waste materials using NIR spectroscopy. The NRT SpydIR® Optical Sorters utilize NIR spectroscopic information to detect and eject 99% by weight of all non-black PVC

materials from a waste stream when installed, operated, and maintained according to NRT recommended procedures. The standard NRT SpydIR[®] can identify and eject materials that are four square inches or larger. Smaller materials require the NRT SpydIR[®] HR (high resolution) optical sorter which is capable of detecting and ejecting materials as small as 0.1 square inches. Feed stream materials are to be evenly distributed in a single layer across the width of an accelerating conveyor belt surface without overlapping, settled on the belt, and moving at a conveying speed of approximately 600 ft/min.

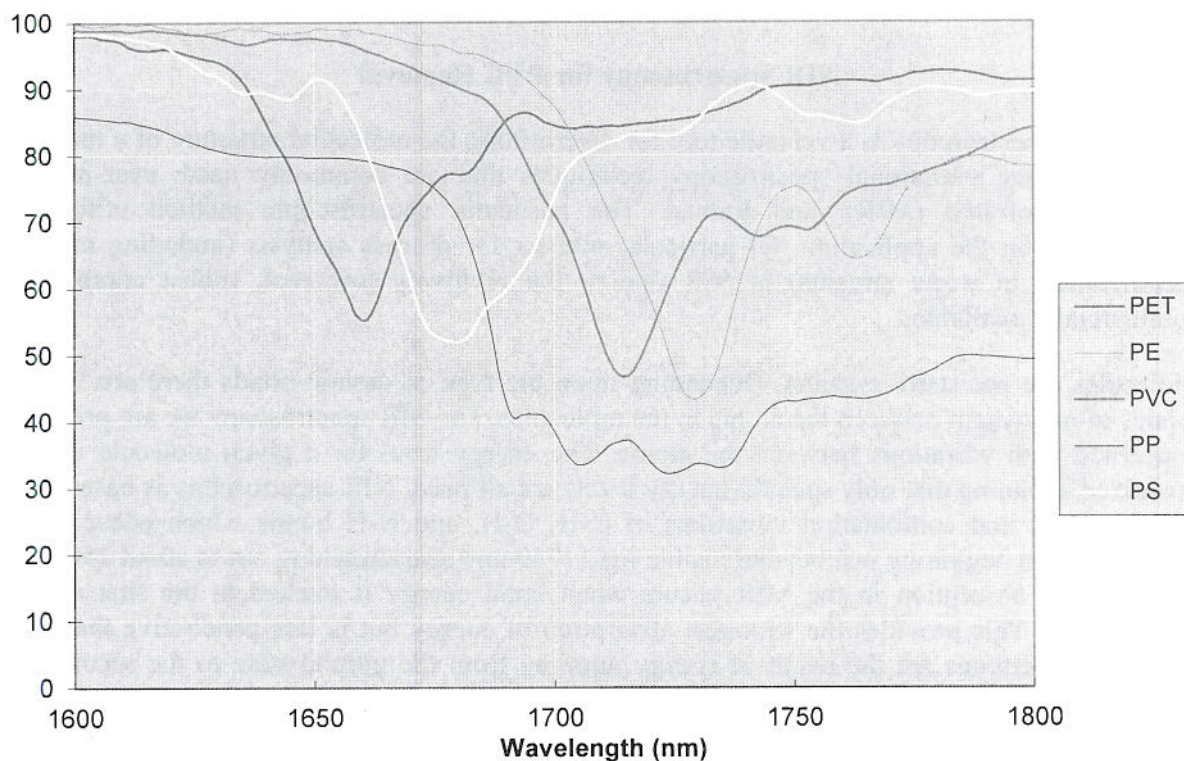
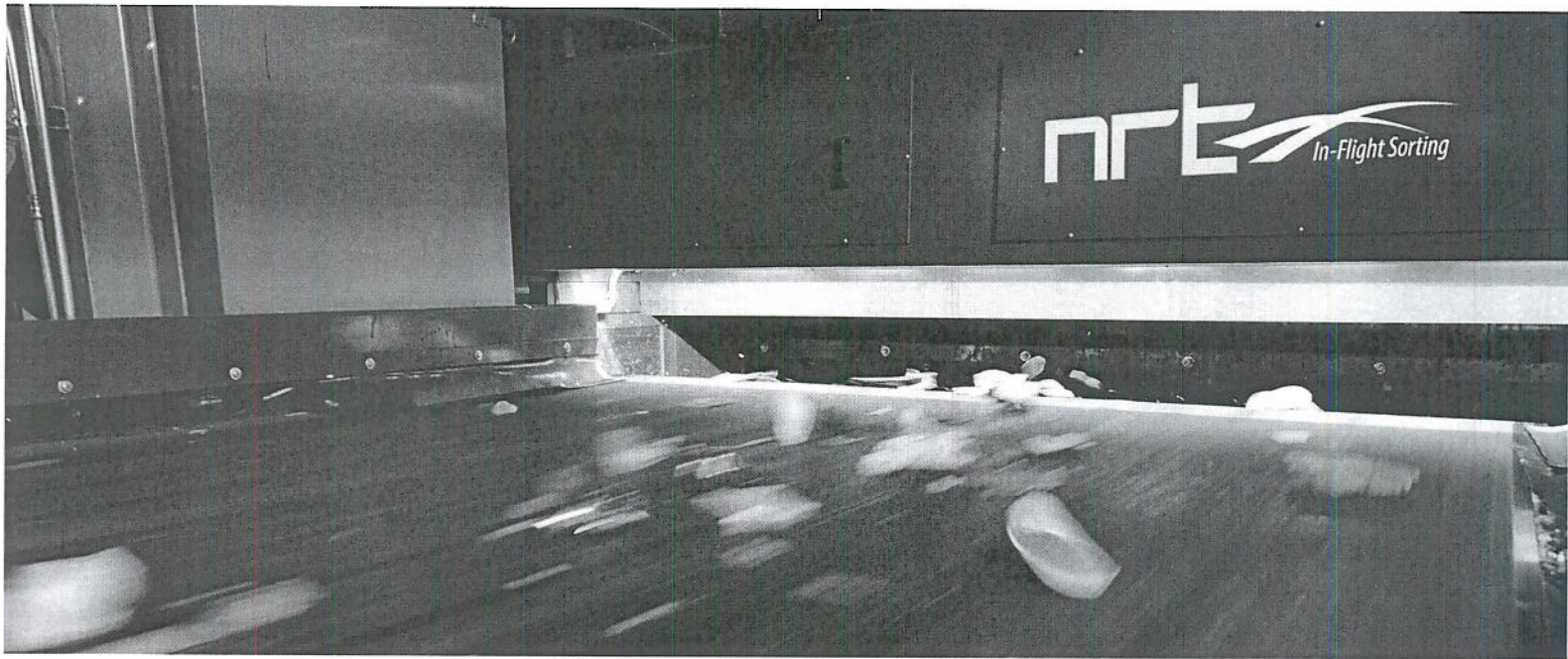


Figure 1: NIR Spectral Data



nrt

Company Overview

The NRT Difference

In-Flight



In-Flight Sorting

NRT units detect and eject material while it is in flight after it has left the belt. Others typically detect over the belt and then eject material some time later. This distinction makes all the difference.

In-Flight Sorting reduces motion-related error

Eliminates signal error from belt interference

Full array of spectrometers allows for identification across entire belt width

Enables use of transmissive detection

X-Ray Technology

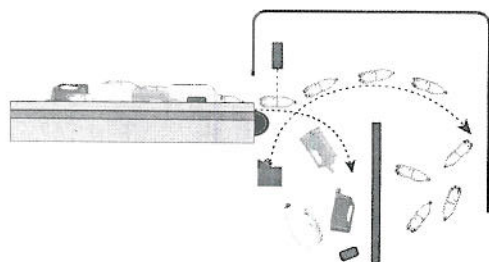


NRT was the first to sort PVC from mixed plastics using X-ray technology in the early 1980s. Today, NRT continues to lead the industry in X-ray technology for a variety of applications. The NRT TruSort™ with DXRT™ technology is an advanced multiple energy X-ray sorting system designed to separate materials at high throughput rates. The potential for this technology is expansive: some uses include RDF/SRF preparation, metal sorting, glass and e-waste processing, and removing contaminants from organics and mineral streams.



Technology ahead of the rest: In-Flight Sorting enables either transmissive or reflective sorting

Transmissive Detection



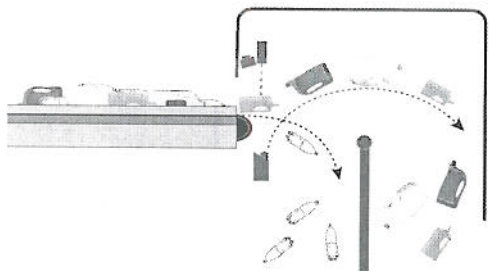
Detection signals are stronger and cleaner – Best signal-to-noise ratio

Highest accuracy for transparent material; ideal for PET stream

Transmissive detection reads through the entire bottle wall and improves accuracy by:

- Providing a more robust polymer identification
- Eliminating interference from labels

Reflective Detection



Detection of opaque polymers such as HDPE and PVC

Accurately detects and ejects In Flight

Extremely low maintenance cost



nrt *In-Flight Sorting* **ColorPlus**

Markets



MRFs

NRT sorters are used in the largest and most advanced MRFs in the world. As a component of Bulk Handling Systems' (BHS) integrated solutions, NRT systems sort plastics, metals, wood, aseptic containers and organics at industry-leading efficiency and purity rates.



Plastics

Types and colored polymers can easily be identified with NRT's advanced technology. Custom sorts can be configured and/or easily changed to suit the requirements of changing market conditions. NRT has proven installations that are achieving leading purity rates sorting bottles, flakes and granulates.



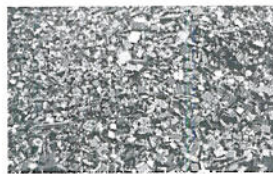
RDF

NRT's technology mix efficiently removes PVC, PET, metals, glass, stones and other contaminants from a refuse derived fuel (RDF) stream, ensuring high value commodities are captured and emissions are controlled. It can also provide real-time analysis of the composition of finished RDF, providing operators with confidence in their fuel.



Biomass & Minerals

Our patented technology is able to precisely identify contaminants in organic streams. Whether it's cleaning glass, plastic or metals from compost, or purifying a minerals stream, NRT has the solution.



E-Waste

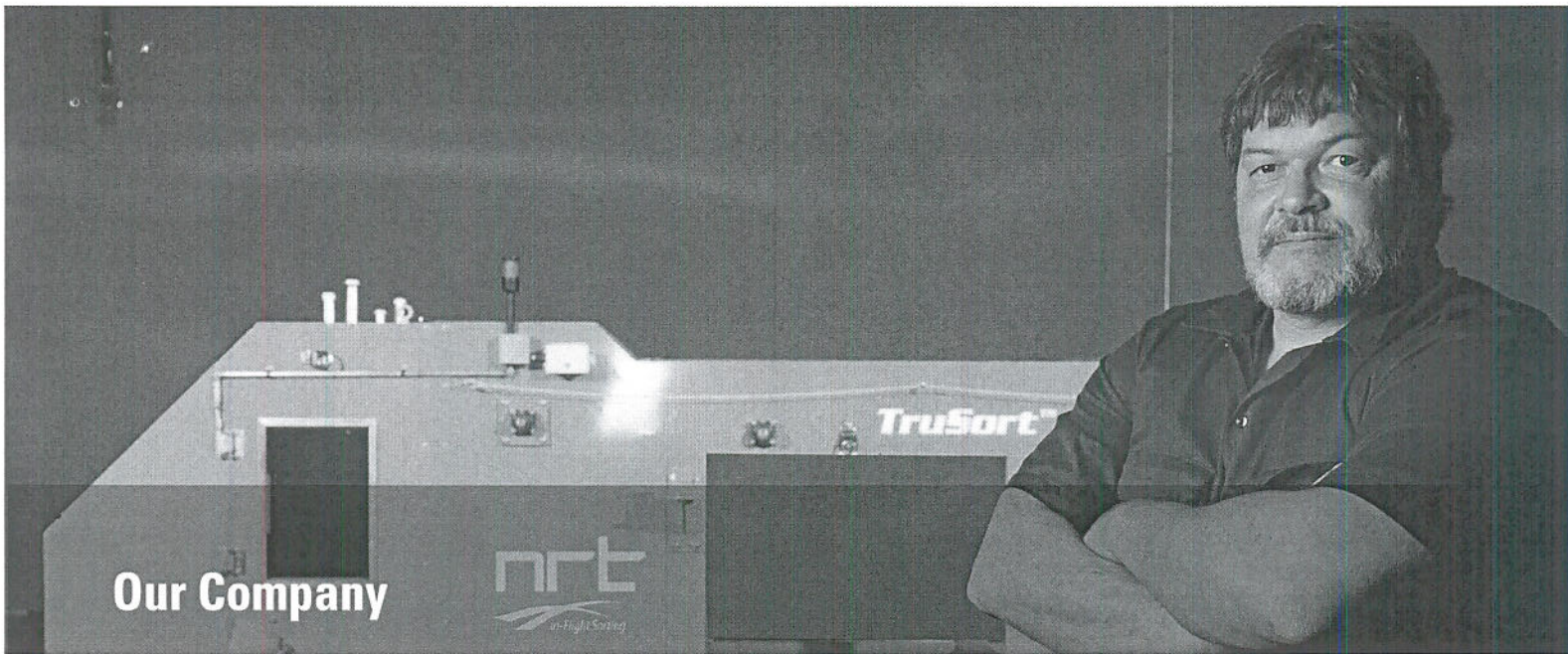
The shorter life cycles on all electronic equipment is creating a growing demand for the proper recycling of computers, cell phones, televisions and other electronic devices. NRT provides complete systems for processing circuit boards, precious metals, plastics, panel glass, funnel glass and other commodities in this rapidly expanding market segment.



Diagnostics

NRT's technology can provide real-time analysis of the composition of practically any material stream, providing valuable information and feedback.

nrt



Our Company



People

Located in Nashville, Tennessee, NRT is a leader in designing, manufacturing and installing optical sorting technology. Since our inception in 1981, our people have been industry thought-leaders and innovators. Today, we apply our technology in automated industrial inspection systems and materials handling and process control, particularly in processing materials for recycling. Our team is focused on technology innovation, quality of manufacturing and a strong commitment to our customers.

Technology

During the past 30 years NRT has developed dozens of technologies and advances for use in Color, Near Infrared (NIR), X-Ray and Line Camera Sorting applications and systems. Today NRT owns or is the exclusive licensee of 29 U.S. patents and five foreign patents covering these disciplines, with others pending. Utilizing top-of-the-line technology and components, our equipment features scan rates of up to 10,000 scans-per-second and boasts industry-leading capture rates.

Quality

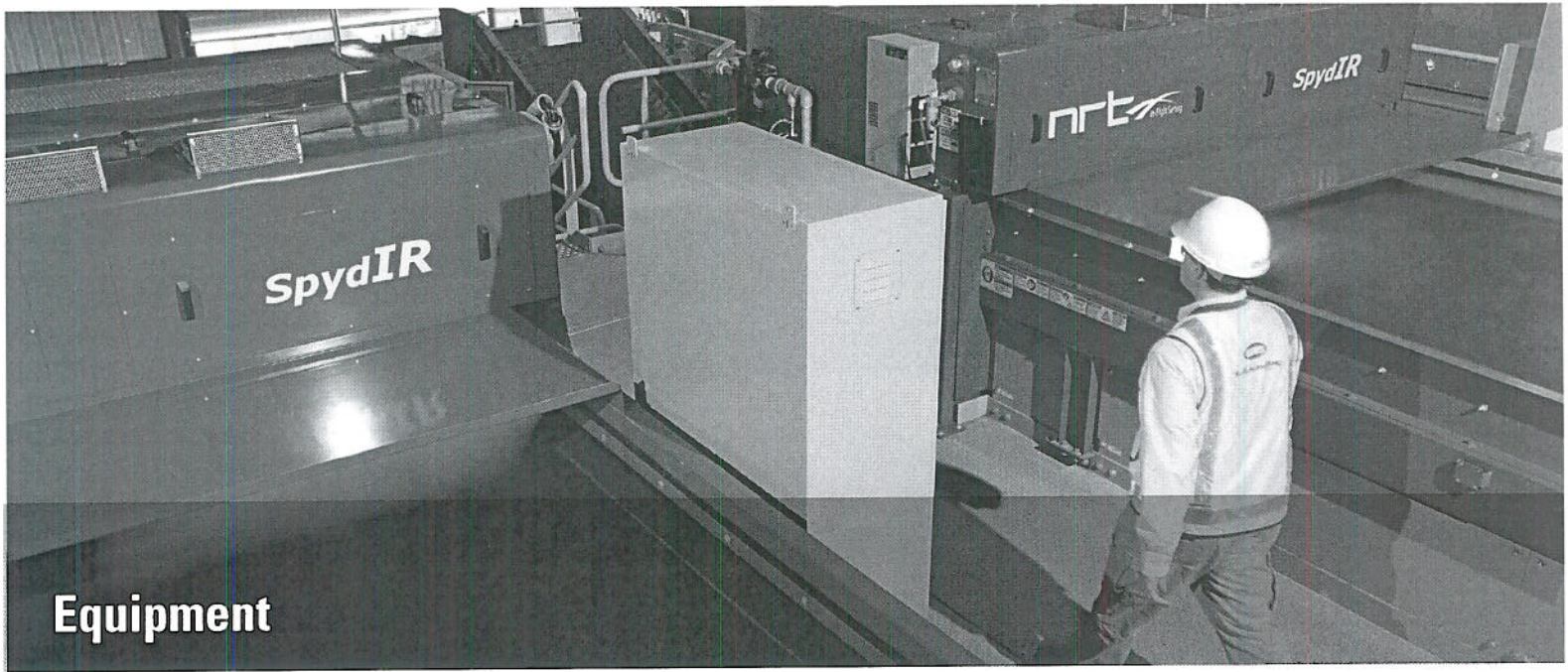
NRT equipment is designed, manufactured and fully supported from its headquarters in Nashville. All intellectual property is fully owned by NRT, providing the control and excellence needed for second-to-none sorting performance. Controlling all aspects of the technology components and manufacturing process, we know that our equipment will meet your performance needs now and in the future.

Customer Service

NRT has more than 30 years of experience exceeding the support requirements of our customers. With a team of field technicians devoted to customer performance and total remote diagnostics and support via a secure internet connection, you can be certain that your NRT equipment generates the results you require.



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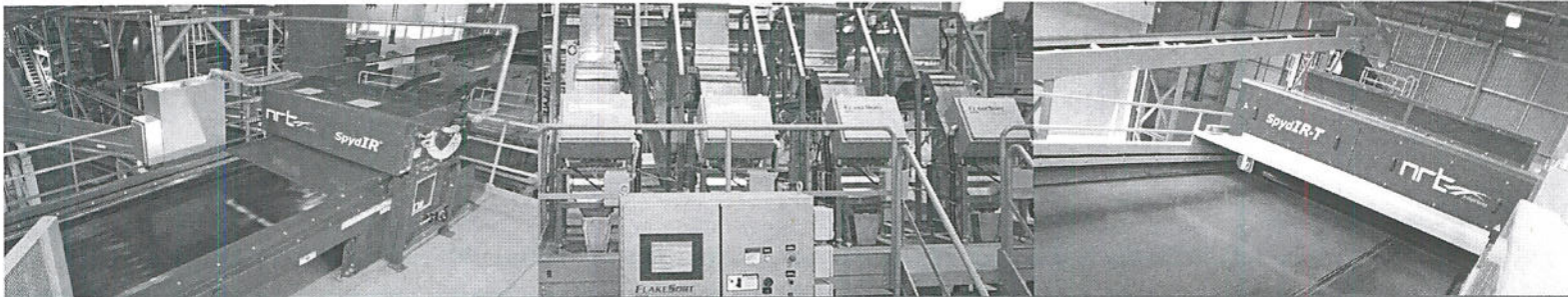


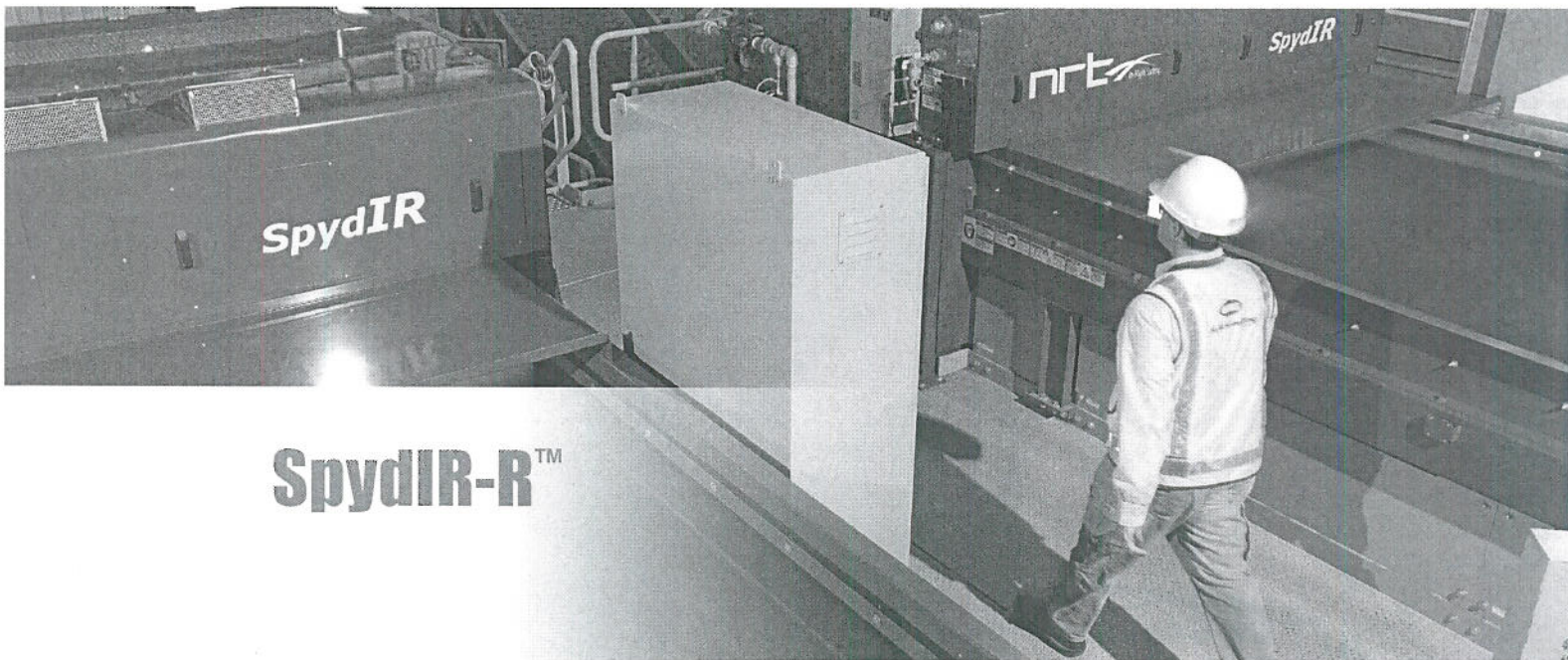
Equipment

| Markets | SpydIR™ | MultiSort® IR | Combo | ColorPlus™ | TruSort DXRT | TruSort™ XRF | Metal Director™ |
|----------------------------|---------|---------------|---------|------------|--------------|--------------|-----------------|
| Single Stream and MSW MRFs | ● | ● | ● | ● | | | |
| Secondary Plastics | ● | ● | ● | ● | | | |
| E-Waste | ● | ● | ● | ● | ● | ● | |
| Construction & Demolition | ● | ● | ● | | ● | | |
| RDF Preparation | ● | ● | ● | | ● | ● | |
| Organics | | | | | ● | ● | |
| Power Generation | | | | | ● | ● | |
| | NIR | | VIS/RGB | | X-ray | | EM |

Detection Types

| | |
|-------|--|
| NIR | Near infrared spectrometry |
| VIS | Visual spectrometry |
| RGB | Color line scan camera |
| X-ray | DXRT (Dual Energy X-Ray Technology) or XRF (X-Ray Fluorescent) |
| EM | Electromagnetic metal sensor |

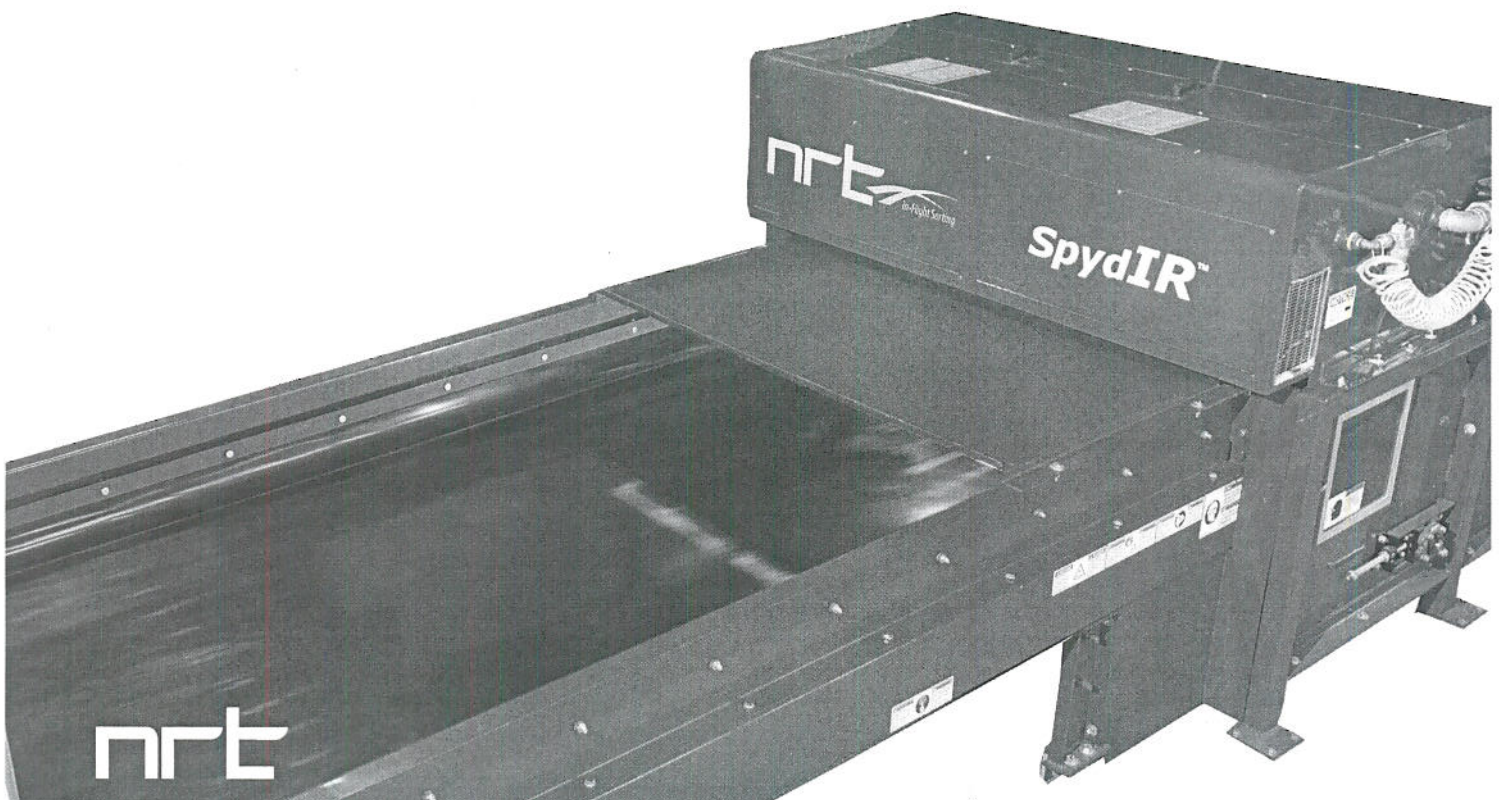




SpydIR-R™

IR *In-Flight Sorting*

Overview The SpydIR-R™ is an advanced infrared sorting system that separates numerous selected polymers from a mixed stream. It uses proprietary technology and fast, highly sensitive algorithms to rapidly identify unique polymer signatures from their infrared spectra. This advanced technology is available in two models: the SpydIR-R™, which uses reflective detection, and the SpydIR-T™, which utilizes transmissive detection. While other optical sorters detect material over the belt and eject some time later, NRT offers In-Flight Sorting, which detects and ejects material in flight. In-Flight Sorting enables the use of transmissive detection and eliminates motion-related error and belt interference, increasing purity levels and hit rates.



SpydIR-R™

IR *In-Flight Sorting*



Technology

- NIR identification of multiple polymer types
- Proprietary infrared sensing technology and algorithms for rapid detection
- Self-cleaning infrared sensing system
- Operator-friendly color touch-screen graphic control panel

Applications

- Sorts 1-7 plastics in any combination
- Single sort high-purity clear and light blue PET directly from container stream
- Separate WEEE plastics into user-defined polymer groups
- Recover clean PET product from polymer residue streams for return to main PET stream
- Remove polymer contaminants from a PET container stream with high accuracy, including PVC, PS, PETG, PLA, PC, PE, PP and other polymers in any combination
- Recover wood product from C&D streams
- Sort Tetra Pak®, aseptic and PE coated gabled products from a container stream
- Remove cardboard, paper, and other fiber from a container stream

Features

- In-Flight Sorting provides unbeatable purity and hit rates
- Industry leading signal-to-noise ratio is ideal for thin-wall PET
- High speed identification with throughput rates exceeding 16,000 lb/hr
- Remote diagnostics, adjustments and upgrades
- Width sizes from 24" to 120"



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